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"Introduction" to *Modeling Complex Systems: Volume 52 of the Nebraska Symposium on Motivation*

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Introduction

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Capturing the complexity of human behavior has been a recurring theme in the Nebraska Symposium on Motivation:

> We expect behavior to be patterned or integrated, and to make biological sense; and so patterning and biological utility are what we see. And of course what we see is actually there—behavior in general is not chaotic; it is organized. (Nissen, 1954, p. 314)

> When fundamental psychologists do make excursions into the human motivational world . . . it is rare that they survey the requirements for theory or pre-theory by intensive descriptive analysis of behavior related to such motives as produced by concrete human beings. More remote still is the chance that anyone will select for illustration, let alone analysis, behavior or experience relevant to man in his most characteristically human performances: man as he creates or loves or plays or responds to the aesthetic surfaces of the human and natural environment. Such matters are threateningly complex. (Koch, 1956, pp. 64–65)

> I have tried, first, to show that it is possible to formulate a meaningful theory of complex motivation by analyzing the

> sorts of variables involved, together with their interactions. I have sought, second, to show that we possess, now, many sound and useful concepts and techniques to translate these complexities into productive experimental research. I suppose the moral is: be not afraid of complexity. If motivation is indeed complex, then let us find the means to cope with it. (Vinacke, 1962, pp. 42–43)

> Through the representation of a few very simple psychological concepts, in a rudimentary mathematical way, a good deal of complexity can be generated. . . . Let us now proceed to generate complexity from simplicity. (Burke, 1966, pp. 49–50)

> Although disorder may be experienced and expressed in highly patterned processes of human activity, it is diverse, individually unique, and systemic; we shall advance in our attempts at conceptualization and classification only as we are willing to embrace the limits of symbol systems to capture human uniqueness and the ultimate ineffability of complex system dynamics. (Mahoney, in this volume, pp. 265–266)

The contributions to this volume of the Symposium describe contemporary approaches to the modeling of complex psychological and behavioral processes, ranging from molecular to molar phenomena. Although the contributions reflect a range of theoretical and epistemic perspectives, they all explicitly or implicitly incorporate complex frameworks of dynamic, system-like relations involving perception, learning, concept formation, emotion, motivation, intention, behavior, and the social context in which behavior occurs.

One special feature of all the contributions from this particularly distinguished group of theorist-practitioners is an emphasis on practical applications of the conceptual frameworks in which they work. This reflects an important idea in the zeitgeist of the contemporary scientific community, that of *translational research*. Translational research is a process of translating the principles and truths that emerge from basic science into practical applications. The complexity of the processes captured in the contributors' models enhances the models' applicability to the complexities of clinical practice, industry, and education. To consolidate the relevance of application

and translational research, this volume ends with a volume editors' postscript, describing a practical model for the complex processes of rehabilitation, as manifest in rehabilitation services currently evolving in Nebraska.

Translational research demands, not just practical application, but continuity with theory and basic science. This converges with the historic role of the Nebraska Symposium as a prominent (and now the oldest sustained) forum for psychological theory. All the contributions in this volume emphasize the theoretical basis of application and the necessity of logical and conceptual continuity in understanding complex processes.

In the first contribution Richard W. J. Neufeld discusses the advantages of formal mathematical theory for illuminating relations between variables as they interact in experimental science. He applies these advantages to the clinical practice of assessing cognitive impairments. Decrying a continuing overreliance in much psychological research on statistical analyses associated with Fisher and Pearson, Dr. Neufeld asserts that formal mathematical modeling of cognitive processes will, ultimately, lead to greater theoretical clarity about normal and abnormal cognition and better clinical-assessment techniques. It is noteworthy that, while the tradition of mathematical modeling in psychology has a long and honored past, the increasing availability of powerful computational tools (e.g., computers and analytic software) supports the kind of sophisticated modeling in the hospital or clinic that was impractical in earlier decades.

At a more general level, Dr. Neufeld characterizes his approach as a novel form of construct validity, one based on the inherent mathematical properties of the cognitive processes he studies. In this sense his contribution is a sophisticated exemplar of the use of complex modeling to achieve traditional theoretical goals of experimental and clinical psychology, as articulated by such historical figures as Lee Cronbach and Paul Meehl.

In the next contribution, Wolfgang Tschacher and Zeno Kupper provide a synthesis of dynamic systems theory and current cognitive science. Inspired by the historic role of Gestalt psychology in the evolution of cognitive science, their discussion invites us into the heart of psychology's theoretical legacy. Drs. Tschacher and Kupper then apply their perspective and methods to the complex realm of psychopathology. They present data sets and analyses from recent

research with people diagnosed with schizophrenia and demonstrate the importance of tracking individuals with multiple measurements over time in order to detect oscillations or trajectories in rehabilitation and recovery that would be missed in the typical cross-sectional approach. Using a time-series analysis, they identify unique patterns or dimensions of intrasubject characteristics that have complex but meaningful interrelations. Returning to theoretical principles, they show how complex, dynamic formulations can be translated into useful clinical instruments and methods. Finally, in a tribute to the Nebraska Symposium's historic focus, their contribution culminates with a characterization of *motivation* as identical to the ongoing action of complex human cognitive processes operating to order and simplify a complex world.

A second exemplar of complex modeling to achieve traditional goals is provided by Suzanne P. Lajoie. Dr. Lajoie uses theoretically grounded performance modeling in the development of computer-based "intelligent" tutoring systems designed to help learners master the complexities of real-world endeavors. Learning how experts go about problem solving and decision making through "cognitive-task analysis" is an important aspect in the process of developing an effective tutoring system. Dr. Lajoie highlights the importance of discerning experts' relevant "dimensions of expertise" (e.g., self-monitoring), as expressed in a specific context, in developing effective models. She also emphasizes the importance of other variables, e.g., emotional, motivational, and social, and she describes strategies for determining *what* to model, *whom* or *what* should serve as the model, and *how* to model the content and/or process. She then translates these principles into design considerations for effective educational technology.

The next contribution extends application of complex modeling from education to knowledge management. Mark A. Musen discusses past and current efforts to develop computer applications to support decision making and data representation in health care. Dr. Musen's theory base is not psychology or neuroscience but artificial intelligence. His technology is the technology of computer engineering. Nevertheless, he envisions a future role for psychology in the development of artificially intelligent systems to manage our already enormous and rapidly expanding knowledge base. It is noteworthy in this regard that psychology has drawn from engi-

neering as much as vice versa, from radar-inspired signal detection models of perception to band-filter models of attention to computer models of executive cognition. Herbert Simon, in his 1994 Nebraska Symposium on Motivation contribution, cited artificial intelligence as a promising model for human cognition. The impact of complex models for knowledge management may be in psychology's future rather than its past.

In the next contribution, Eduardo Salas, Kevin C. Stagl, C. Shawn Burke, and Gerald F. Goodwin scrutinize complex processes associated with small groups of people brought together for common purposes. They advance "the science of teams" by providing a detailed review of representative models of team performance in organizations and other naturalistic settings generated over the past quarter century. In their review, Drs. Salas, Stagl, Burke, and Goodwin find the invocation of *input-process-output* (IPO) models, consonant with the "general systems" framework that has influenced many areas in the social sciences during the past several decades, to be a key commonality among these models. There is greater diversity among models with respect to emphasis on internal team processes versus greater attention to the influence of external, contextual factors. The authors conclude that both influences are important and that, consequently, more sophisticated modeling techniques are needed to successfully deal with the resulting dynamic complexity, particularly in naturalistic settings.

Drs. Salas, Stagl, Burke, and Goodwin then turn to a description and elaboration of a new and unique multilevel integrative framework for understanding team functioning. This new model is distinctive in the importance that it attaches to individual team members' cognition as an important moderating variable as well as group decision making, shared mental models, and external factors.

Michael J. Mahoney's contribution is a nuanced interlacing of several kinds of "models," including verbal metaphor, narrative, photography, and poetry. Dr. Mahoney discuses various perspectives on "complexity" theory and its precursors in philosophy and science, including current theoretical frameworks such as dynamic systems theory, complexity studies, and chaos theory, placing them in the context of the history of ideas. He describes and elaborates on *constructivism*, an integrative framework and family of theories. Dr. Mahoney's contribution includes two appendices. The first provides

a synopsis of important aspects of human change from the perspective of constructivism. The second provides rich and provocative perspectives for incorporation in the practice of counseling, psychotherapy, coaching, and other educational pursuits.

Complexity, Systems, and the Nebraska Symposium on Motivation: A Brief History of Ideas

The perspectives reflected in this volume are exemplars of an evolving set of conceptual frameworks that influenced thinking in many areas of science during the second half of the 20th century. These frameworks are most generally associated with *general systems theory*, and addressing complexity is one of their key common features.

Having recently celebrated a half century of the Nebraska Symposium on Motivation, as this volume's editors we saw a useful purpose in reviewing the more than 300 individual contributions that constitute the previous volumes, to identify ideas that anticipate or shape the approaches to complexity that we find in contemporary work. We found a richness of such ideas, so many that only a few can be highlighted here. The remainder of our introduction to this volume is a review of five especially resonant contributions from volumes past: Heider (1960), Walker (1964), Leeper (1965), Newcomb (1953), and Barker (1960). We selected contributions that, in addition to showing the nascent ideas about complexity and systems theory discussed in this volume's contributions, have clear relevance to practical application and translational research and especially to our own particular interests in physical medicine and psychiatric rehabilitation.

One common characteristic of systems theories is an organizational scheme that orders specific mechanisms and processes according to their respective complexity. Two terms from classic learning theory, *molar* and *molecular*, serve to define the poles of these schemes. Processes and mechanisms are molar rather than molecular to the degree that they represent the integrated interaction of multiple components. Psychology itself reflects this type of ordering, ranging as it does from theories of neuronal activity to neuropsychology to the psychology of social cognition and interpersonal behavior. The historical Nebraska Symposium contributions reviewed here follow

a molecular to molar rather than a chronological sequence. Interestingly, contributions from common theoretical perspectives can differ with respect to the molecular-molar dimension. Heider (1960) and Barker (1960) integrate classic Gestalt principles with subsequent theories, but Heider addresses comparatively molecular expressions of key processes, while Barker is at the other end of the continuum, addressing "spontaneous" organizational processes at the level of a human community. Other contributions to be reviewed address system organizational processes at the cognitive level (Walker, 1964), the emotional level (Leeper, 1965), and at the social/interpersonal level (Newcomb, 1953).

We have included extended excerpts from the original contributions, in an effort to preserve the style and tone of the original presentation. Also, we hope to provide enough of the language in sufficient detail for readers to draw their own conclusions about the relation of the historic ideas to those of the present volume. However, these passages cannot fully convey the logic or the eloquence of the source materials. The reader is encouraged to consult the full chapters in areas of particular interest.

Fritz Heider (1960)

Many Symposium contributions have included Gestalt psychology frameworks offering concepts and models that resonate with contemporary perspectives (e.g., self-organizing systems) that, in many cases, evolved from earlier, traditional Gestalt investigators. An exemplary illustration is Fritz Heider's "The Gestalt theory of motivation" (1960).

Heider's work has been more influential on certain theorists than the relative paucity of scientific citations would indicate. George S. Klein, then editor of the journal *Psychological Issues* (itself representative of the rise of interest in ego functioning in the psychoanalytic literature the 1940s and 1950s), provides a brief preface to a set of selected papers published as Fritz Heider's monograph *On Perception, Event Structure, and the Psychological Environment* (1959). In addition to describing Heider's unique viewpoint, Klein's comments highlight important aspects of the view of rehabilitation and the notion of *participation* as an important goal of rehabilitation (World Health Organization, 2001). The

ideas presented have direct relevance to current models of rehabilitation and crucial aspects of participation and quality of life, each intimately associated with the behavior settings available to the individual, the quality of his or her social networks, and other variables that will be discussed in the final section of this introduction.

According to Klein (1959): "Fritz Heider's work . . . has had over the years a significant, if relatively unobtrusive, impact on some of the most important theorists of our time, notably Kurt Koffka, Kurt Lewin, and Egon Brunswik. More recently, Heider's influence has been detectable in perception theory, for example, in the work of James Gibson. Still, his writings cannot be called 'popular'" (p. v). Klein continues:

> Heider's emphasis on the "*macro*physics" of things (in contrast to the reductionist emphasis on *micro*physics), the important distinction he develops between those parts of the environment which mediate ("medium") and those which are mediated ("thing"), his analysis of how we may distinguish behavioral events attributable to the structure of the environment and those attributable to the structure of the perceptual system—all of these merit close study. . . .
>
> Throughout the papers the composition of a "unit"—whether spatial, temporal, or causal—is of central importance to Heider's distinction between "thing" and "medium." The defining properties of a "unit," therefore, come in for extended and penetrating analysis. . . .
>
> Heider has made [an attempt] to penetrate the essential nature of the concept of structure. The general macrostructures which he describes may apply to their subjective counterparts in ego organization. . . .
>
> A unique feature of Heider's approach is his attempt to fathom environmental structure not from the response side—from the inside outward, as it were, as is common in psychological theories—but from the outside inward, that is, by specifying the architectural rules of the extrapersonal world of physical object and event units. The result, then, is an extraordinarily fresh confrontation of the external structures which are assumed but never specified in psychoanalytic notions of reality testing and adaptation. (p. vii)

In his Symposium contribution Heider provides an overview of four "thought models or schemata" characterizing the Gestalt tradition at the time. Heider terms the initial model the *classic Gestalt theory*. The model is based on the work of investigators such as Wertheimer, Köhler, and Koffka. Describing this model, Heider highlights a number of aspects of this perspective that bring to mind such concepts as *patterning* and perceptual organizing processes that seem quite consistent with concepts used today. Heider begins by emphasizing the Gestalt concept of *good figure*, advanced by Wertheimer, who applied it to visual processing:

> This principle states that the perceived figure tends to be as good as the stimulus pattern will allow, or as Koffka says: "Psychological organization will always be as 'good' as the prevailing conditions allow. In this definition, 'good' is undefined. It embraces such properties as regularity, symmetry, simplicity and others. . . ." For instance, slight irregularities in the shape of visual forms are usually not noticed. Kohler gives the following example: Faces of people usually appear to us symmetrical, in spite of the fact that they are rarely objectively symmetrical. We may notice this irregularity in another person's face when we look at his mirror image; but ordinarily we don't see it.
>
> Kohler has called attention to the fact that a tendency towards simplicity can also be observed in physical systems, as, for instance, Ernst Mach has pointed out. Kohler gives many examples in his book on *Physical Gestalten* [1924]. . . .
>
> Let us recapitulate: Wertheimer observed the tendency toward good form with percepts; Kohler then related this observation to a similar tendency found in physical systems. Of course the same tendency is then assumed to rule the process in the physiological brain field. Since isomorphism is assumed, all this fits very well together.
>
> The thought model is one of a complex process with many part events which interact in such a way that a certain end-state is reached, an end-state which is in some way distinguished, and which has characteristics the other possible states do not have; as long as this end-state is not reached something will happen. On the other hand, when it is reached, the process attains an equilibrium and nothing more will happen.

> Furthermore, the end-state will come about regardless of what the beginning state of the system is: thus one can talk about a tendency, which implies direction, a reaching of the same end-state by different routes. (Heider, 1960, pp. 145–146)

Heider follows his discussion of Köhler's ideas with a perspective from Kurt Koffka:

> It is not surprising that Gestalt psychologists have applied this same thought model to behavior. For instance, Koffka does so in his book on *The Growth of the Mind*, which first appeared in 1921. I should mention that Koffka uses the term "closure" for the distinguished end-state, a closed figure being a better figure than an open one. Tendency to closure is therefore only another name for tendency toward simplicity, or goodness of figure.
>
> This is what Koffka says (Koffka, 1925, p. 103):
>
> > . . . The characteristics of closure . . . belong not merely to the phenomena themselves, but likewise to the behavior taken as a whole, including all reactions made to the environment. Instinctive activity then becomes an objective mode of behavior analogous to such phenomena as rhythm, melody, and figure.
>
> . . . He [Köhler] calls the state toward which the processes in the organism are directed a "standard state." It has to be distinguished from the state of equilibrium (Kohler, 1938, p. 325), and he describes it as follows (Kohler, 1938, p. 303):
>
> > The essential characteristic of regulation is an invariance of *direction*. Whatever initial configuration may obtain in those systems when we begin to observe them—if we observe long enough their inner displacements or transformations will always be found to bring them nearer to a standard status. The word "standard" points here to the fact that the final status is independent of the initial configuration.
>
> . . . Essentially . . . the thought model of a system tending towards a standard state is applied to directed action, and this model had its origin in the principle of good figure. However, . . . when we try to find out how it is carried out, we see that

two steps are necessary for the transition from the phenomena of the visual field to action.

First, we have to take into account not merely perceptual appearances but a space in which behavior occurs; and secondly, we have to consider the objective environment, and the way the organism effects changes in it.

. . . Thus we have to substitute for the visual field what Koffka called the behavioral field and Lewin the life space. This behavioral field is conceived of as having similarities with the visual field. It also is a system containing a great number of part processes which interact, it exhibits forces and tensions, and tends to arrange itself in such a way that a distinguished end-state is reached. This distinguished end-state, in some way comparable to the simple figure, is the state of the person who has reached the goal in his life space. Now, this life space or behavioral field is a concept which involves many difficulties and unsuspected depths and snares. . . . I can only say that in a first approximation, which, however, is not entirely correct, one can conceive of it as representing the environment of the person as the person himself experiences it—and it is in some way related to the brain field, to physical processes going on in the brain. The Gestalt psychologist would characterize this relation as one of isomorphism, i.e., of structural similarity. This is the first step we have to accept when we apply the principle of good form to activity: namely, the step from perceptual to behavioral field.

The second step requires a more extensive consideration. So far we have only considered processes which are "inside" the organism in some way, which are "encapsulated," as Brunswik says. How is it possible that they produce effects outside the organism, in his physical environment? We assume that this behavioral field changes in the direction of a distinguished state, maybe a state of minimal tension, i.e., the state of the person being at the goal. But . . . we have to understand how the tension in the behavioral field makes the person reach the goal in reality. (Heider, 1960, pp. 147–149)

He later continues:

In action, not only a part of the organism, but the whole organism is involved. . . . The idea of the feedback or circular process

> can be applied also in this case: as long as the person has not yet reached the goal, there is a tension in the behavioral field; this tension is communicated to the executive system, which changes the relation between organism and objective environment in such a way that the goal is reached; via perception this objective state is communicated to the behavioral field; and thus the tension in this field is removed. I have used the term "feedback" to characterize this process. However, one has to keep in mind that this circular process is not a simple feedback process. What distinguishes the circular process of Gestalt theory from simple feedback is the interpolation of the behavioral field with its tendency towards a *distinguished state* [emphasis added]. (p. 150)

Heider goes on to describe two models advanced by Kurt Lewin—the *person model* and the *environment model,* together constituting what Heider terms Lewin's *spatialized psychology.* He notes the move from the perceptual sphere to the behavioral realm in Koffka's work and what Lewin terms the *life space.* Heider's discussion of Lewin's concepts is thought provoking, and the reader is encouraged to review those concepts in the source material.

Heider then offers a relatively brief summary of his own recent theorizing, describing what he calls his *balance theory,* which he feels answers some questions left inadequately treated by the classic Gestalt theories he has summarized:

> This theory of balance deals mainly with configurations consisting of a number of entities between which exist certain relations. The entities can be persons—the own person or other persons—and other entities, as for instance, things, situations, or groups. The relations considered are mainly of two sorts: on the one hand attitudes of liking or disliking, and on the other hand unit relations of belonging. The main idea is that certain of these configurations are preferred, and that, if circumstances allow, they will be realized by the person either in such a mental reorganization as wishful thinking, or in an actual change through action. . . .
>
> In recent times a number of theories have been proposed which are similar to the one just outlined. I remind you, for instance, of Newcomb's (1953) discussion of processes of com-

munication [see below]. . . . These conceptions, symmetry, consonance, balance, and simplicity, are, of course, implied in that idea with which Gestalt theory started and which always was central to it, namely, the idea of a 'good' figure. We therefore have returned to the model we considered first. This model implies a number of different entities with certain properties and standing in certain relations, which make up a constellation of factors tending toward a standard state.

The properties of these configurations which determine their meaning and their fate are whole-qualities. Consonance or simplicity of the structure cannot be derived from the properties of the parts . . .

If we study the *p-o-x* system[1] which is composed of the own person (*p*), another person (*o*), and an impersonal entity (*x*), then we find that the state of balance depends on the attitudes of *p* toward *o* or *x*. That is, the attitudes toward the parts of the configuration, and the relation of these attitudes to each other enter as significant factors, and determine the attitude toward the whole configuration. . . .

Thus, we are able to specify more exactly the conditions of goal selection, at least in some cases. The goal is not taken to be an unanalyzed entity which in some way acquired valence, but is derived from the properties of the structure [emphasis added].

. . . [The] difference between Lewinian theory and balance theory [is] in regard to the role structure plays. In Lewin's environment model . . . structure is not intimately connected with the conditions of tendencies, nor with their effects. Structure helps us to derive the direction toward means from direction toward goal; but it does not help us to derive the direction to the goal. . . .

. . . Thus we see that in these [Lewin's] models the dynamic factors are not very closely linked with structure. Neither do the properties of the structure imply forces, nor do the forces affect the structure in a specifiable way.

In the balance model the dynamic factors are intimately connected with the structure. The dynamic factors arise out of definable structural characteristics and the forces toward the standard state tend to change the structure in definite directions.

> . . . [Unlike Lewin's models], in the balance model structure in a state of equilibrium is definably different from one in a state of disequilibrium, and all the parts of the structure are relevant to this difference, not only the relation between two parts, person and goal. (Heider, 1960, pp. 167–170)

Edward L. Walker (1964)

Edward Walker's contribution to the 1964 Symposium, entitled "Psychological complexity as a basis for a theory of motivation and choice," is generally congruent with Heider's (1960) views, though the terminology employed by these scholars and the associated research traditions from which they come are quite different. Walker (1964) provides a concrete example of model building as well as an interesting perspective on the concept of *complexity* and mechanisms that contribute to the organization and self-regulation of behavior at the level of the organism. Also, as with Heider's view, mechanisms of perception, cognition, learning, adaptation, and motivation are all seen as quite interdependent and quite closely related to environmental stimulus context.

Walker states at the outset:

> This paper is an attempt to state what I believe to be the most basic questions of behavior theory, to elaborate the concept of psychological complexity as a potentially unifying concept, and to test its clarifying contributions with respect to some critical problems of behavior theory.
>
> The three basic questions of behavior theory are . . .
>
> 1. What is the mechanism that terminates an event?
> 2. What are the determinants of the next event?
> 3. What is the fate of an event after it is terminated? (Walker, 1964, pp. 48–49)

He follows precedent in setting the temporal length of a psychological event at 0.5 seconds. Then he asks:

> When an event is terminated, what are the determinants of the next event? A great many subareas of psychology are devoted to an effort to discover and quantify the determinants of choice behavior. . . . "Habit," "motive," "subjective probability," "util-

> ity," "set," "attitude," and "trait," along with many other concepts in psychology, are reducible to names of intervening variables or theoretical constructs, each related to different sets of operations, but all, ultimately, determiners of choice behavior.
>
> It will be the argument of this paper that the concept of psychological complexity can be used to account for the termination of psychological events, and the choice of the next event over a wide range of traditional concepts of determiners of choice. Thus, the concept of psychological complexity can be useful in answering the first two of the three basic questions. Psychological complexity can also be used to account for many of the phenomena associated with the trace of a past event, but this third basic question or problem is beyond the scope of the present paper. (pp. 51–52)

Under the subheading "Psychological Complexity Theory," Walker asserts:

> The major distinction that must be made is between "stimulus complexity" on the one hand and "psychological complexity" on the other. The first is a characteristic of the external stimulus, more or less independent of the individual organism. Psychological complexity is a characteristic of the event itself, the organism's response. Psychological complexity and neural process complexity will be assumed to be completely isomorphic. (Walker, 1964, pp. 52–53)

In the context of a basic definition of terms, he turns to an elaboration of his concept of *psychological complexity*:

> Psychological complexity is a characteristic of the event itself and is thus a characteristic of the interaction of the organism with the distal stimulus when the event in question is initiated by a stimulus. Thus it is possible for two organisms to react with equal psychological complexity to stimuli with very different distal stimulus complexity values. The same organism may also react with different degrees of psychological complexity at different times to the same stimulus. (pp. 54–55)

Walker offers a brief description of the (assumed) underlying nervous system basis of the experience of optimal complexity, under the heading "Neural Net or Neural Process Complexity":

> Underlying any psychological event, is, of course, a pattern of neural events. Such events are spatially three dimensional and occur over a finite period of time, a fourth dimension. It is assumed that variation can occur in the relative complexities of two neural processes. We shall refer to the relative complexity of a four-dimensional neural process as the relative complexity of the relevant neural net. Furthermore, we shall assume a complete isomorphism between neural net complexity and psychological complexity (Walker, 1964, p. 55).

He offers as relative characteristics of simple versus complex neural net in terms of the four dimensions noted above: "simple" nets consist of processes that are relatively "small," "short," "focal," and "central" (i.e., origin within the central nervous system); "complex" nets are relatively "large," "long," "diffuse," and "peripheral."

Having offered a neurologically oriented substrate, Walker turns to the concept of *psychological complexity* itself. Under the heading "Optimal Complexity," he asserts:

> The key concept of the theory I am attempting to fabricate is the concept of *optimal complexity*. The simplest and most straight forward psychological definition of optimal complexity is the following: *Optimal complexity is that degree of psychological complexity the organism will seek to maintain.*
>
> If a psychological event is more complex than the optimum, the organism will behave in such a manner as to reduce the complexity of the event. If a psychological event is less complex than the optimum, then the organism will behave in such a manner as to increase the complexity of the event.
>
> Optimal complexity can be bracketed by other values of psychological complexity. In perception, an input level far above optimum produces "mental dazzle." A lower limit is a level of complexity that is below the threshold of consciousness. In motor activity, psychological complexity far above optimum results in discoordinated tetany, and there is a lower value which constitutes the threshold for action. The optimum is a "normal" percept or a smoothly coordinated movement. . . .
>
> The sequence is inevitable and the fall in neural net complexity is an automatic result of observable and fairly well understood neurophysiological characteristics. Since neural net

complexity and psychological complexity are assumed to be isomorphic, psychological complexity may be said to rise and fall as well. With a sufficiently complex stimulus, psychological complexity will rise to and exceed the threshold of consciousness, will rise to and exceed optimal complexity, will fall below optimal complexity, will then drop below the threshold of consciousness automatically, and will usually be followed by another psychological event.

[The reader] will recall that the first of the three basic questions of behavior theory was:

What is the mechanism which terminates an event?

The answer is:

Whether the stimulus for an event is continued or not, a psychological event undergoes a sharp and automatic drop in complexity during a period of approximately one-half second after its initiation. (Walker, 1964, pp. 56–58)

With respect to repeated activation of an event, he asserts:

Repeated activation of a neural net will result in a progressive decrease in the psychological complexity of the event involved. (p. 59)

With respect to the second major question (What are the determinants of the choice of the next event?), he continues:

The principle of optimal complexity incorporates the dynamism that the organism will seek such a level. The termination of one event occasioned by the automatic reduction in its psychological complexity below the optimum level, literally forces choice of that event among available next events which will be nearest optimum. Therefore:

Among available alternatives, an organism will choose as a next event that activity which is nearest optimal psychological complexity.

It is assumed as a working hypothesis that many of the major determinants of choice behavior such as reinforcement, habit, motivation, curiosity and other collative[2] variables, subjective probability and utility, and others ultimately can be reduced to a single concept—psychological complexity. (p. 60)

Walker offers a brief recapitulation:

> The theory can be stated in an abbreviated form. During the course of a psychological event that has a duration of approximately 500 [msec], the psychological complexity of the event rises abruptly and falls more slowly. The automatic reduction in the psychological complexity of an event insures that it will drop promptly below the optimum to be replaced by that one of the available alternative events which is nearest optimum. The psychological complexity of alternative behaviors or events will be a function of four variables. They are: (1) the stimulus complexity of the initiation stimulus; (2) the time since this particular event has occurred previously; (3) the number of times that event had occurred before; (4) the arousal properties of the stimulus or event. (Walker, 1964, p. 60)

Walker addresses the issue of what behavior(s) might be expected when no near-optimum event is present. In the case of all available alternatives *below* optimum, an individual might commonly respond in one or more ways (slightly adapting Walker's text):

1. Search the environment or his own repertory for more complex events;
2. Find a more complex stimulus in the environment to which he had not attended previously, or he might fall to daydreaming;
3. React by locomoting, getting up and moving about;
4. Seek arousing stimuli;
5. Seek to differentiate previously unexplored potential complexity in his environment or in old thought sequences and problems.

> All of these devices would serve to increase the complexity level of the sequences of events which are occurring. All would serve to move the sequence nearer an optimal level of complexity. (Walker, 1964, p. 61)

At the other extreme:

> Situations in which the psychological complexity levels are above optimum are usually situations in which the sensory inputs into the nervous system are providing more information than the organism can process. This may result when the exter-

> nal environment is too complex, when the problem one is working [on] is beyond immediate solution, or when the motivational or emotional system is in a highly aroused state. (pp. 61–62)

In such circumstances, he notes common reactions:

1. The organism may shift attention or narrow attention to a limited portion of the stimulus input;
2. If the overload is of external origin, the organism may locomote to a less complex circumstance;
3. If either are difficult or impossible, the organism may attend repeatedly to the same stimulus in an effort, usually successful, to produce a reduction in the psychological complexity of the situation through repeated activation of the relevant event;
4. An associated result of repeated activation is to organize a very complex stimulus into a smaller number of "chunks." (p. 62)

Walker's contribution concludes with a survey and critique of relevant research and theoretical distinctions to provide support for and elucidation of the conceptual framework adduced therein. He buttresses his concept by applying it to existing experimental data that are not easily explainable by any other existing theory. For example, he applies his theory of optimal psychological complexity to the often-observed (but less frequently reported) decremental variations in "conditioned responses" following "learning" experiments that have been taken by many to be unexplainable anomalies. After noting a few such "anomalous" observations:

> For the sake of the argument I am certain to get, let me take the position that the appropriate "learning" curve shape in running studies, conditioning studies, and selective learning studies, is one that rises and falls to zero or to a steady level below the maximum performance. The curve that rises to a steady maximum and remains there indefinitely is likely to be rare. The reason that we see few "learning" curves of the postulated type is that most experimenters know in advance what a learning curve is supposed to look like. As a result of this knowledge, they stop training when the "asymptote" is reached, or, if they obtain a curve which does not fit their conception of what one should look like, they find a great many other ways to respond

> . . . other than to publish their sin against respectability. They throw away their data. They restructure the apparatus. They change the parameters of the study. They change the design. This process is known as the establishment of experimental(er) control. Sooner or later they manage a situation in which they obtain the "right" answer. I can attest that this process is carried out in good faith and under the assumption that in so doing, one is behaving like a sound, rigorous, and careful experimentalist. I can attest to this because I am one of the sinners.
>
> Thus psychological complexity theory handles the usual learning curve, extinction, and the drop in performance that often occurs under continued reinforcement. It predicts that most experimental situations will produce a drop in performance if training is continued. (Walker, 1964, pp. 85–86)

In later comments concerning Walker's presentation, his fellow presenter, Frank Logan, in addition to suggesting caveats to the former's views, concludes with an important observation:

> There are several features of Walker's approach with which I am in strong agreement. A language that avoids the artificial separation of stimuli and responses more nearly captures the unified, interdependent inseparability of psychological events. It is also becoming increasingly recognized that the fundamental behavioral operation of an organism is selection or choice. . . . Walker's attempt to develop a system that can deal with behavior dynamically, i.e., continuously over time, is perhaps the critical feature necessary to achieve a general integration. And, by whatever means, visualizing such disparate concepts as habit, motivation, and decision-making in terms of a single construct certainly is one we should applaud. (Logan, 1964, p. 98)

Robert Ward Leeper (1965)

Robert Leeper's contribution, "Some needed developments in the motivational theory of emotions" (1965), is focused on urging greater attention to understanding *emotions* as motivational factors, rather than "lower," simply "energizing" or "arousing" factors that are then guided by "higher-order" functions (e.g., perception and/

or cognition). In fact, Leeper highlights the ultimately inseparability of processes of perception, motivation, and emotion:

> Still earlier, David Krech (1949, 1950a, 1950b, 1951), in his usual impassioned style, had reasoned that it is unrealistic to conceive of psychological phenomena in terms of separate processes of perception, motivation and learning. Instead, he urged, we ought merely to conceive of "Dynamic Systems." These, he said, are so definitely organic unities that no single aspect of such a system can be changed without changing the other aspects as well—we have been dealing in myths in believing that we could vary some one of these aspects while keeping the other aspects constant. Though proposing a less drastic statement on this point, E. C. Tolman (1932, 1948) had been suggesting some perceptual factors in motivation in his view that motivation is partly a matter of reward expectations and punishment expectations. Kurt Lewin similarly had been discussing many problems of motivation in terms of factors in the organism's "psychological environment." . . . In my own previous writing, my original paper on a motivational theory of emotion (1948) was extended to some extent into the perceptual-motivational theory which has been elaborated in the present paper. . . .
>
> One odd fact about these various earlier discussions of a perceptual or conceptual interpretation of motivation is that their authors have made practically no references to the related ideas of the other papers. This is the more surprising in view of the fact that most of this group are more or less closely related to one another both personally and as regards their general theoretical outlooks and interests. It seems, therefore, as though each of these persons had to grope to the concept on his own, even though possibly helped in ways that he did not recognize by his predecessors or colleagues. I make this suggestion with somewhat more confidence because I remember that, in my own case, when I first read Krech's papers on "Dynamic Systems," they did not make much sense for me. . . . And, peculiarly, it took me a long time to recognize that Lewin's ideas might be thought of as a perceptual theory of emotion. . . .
>
> Maybe this sort of thing will continue to be the case. If a perceptual theory of motivation is to become more common,

> perhaps each psychologist will have to figure it out for himself. (Leeper, 1965, pp. 111–112)

Leeper summarizes some major themes:

> The suggestion that comes from a number of sources, therefore, is, first of all, that emotions are motives, and then, second, that emotional processes, along with all other motives, are perceptual or representational processes. The suggestion that comes is that emotions and other motives do not exist or operate in any less complex sense than this. . . .
>
> Even though perceptual habits are hard to change in some cases . . . it seems that all perceptual habits can be modified by learning and that sometimes such modifications can occur suddenly and dramatically. If emotional habits are perceptual habits, these same possibilities should exist for them. (pp. 113, 115)

Theodore Newcomb (1953)

Theodore Newcomb's contribution, to the very first volume of the Symposium, was "Motivation in social behavior" (1953). Newcomb makes clear that he does not believe that a psychology of motivation in social situations should be fundamentally different or discrepant from a general psychology of motivation. Rather, it should be subsumed by a broader model of motivation that describes human motivation in any situation. However, he also notes that the breadth of such an overarching model would not lend itself to making predictions or heighten understanding of specific processes or variables within a particular subdomain of psychology in general (e.g., individual behavior in a learning situation; behavior in a social situation):

> A general theory, whether of motivation or of evolution of species, is never specific enough to predict within a specific area those details in which we are often most interested. Indeed, it is from the relatively limited theories that the relatively inclusive theories must in the long run emerge. (Newcomb, 1953, p. 139)

The relevance of his contribution to the topic of self-organized systems is seen in his analysis of the dynamics or organization of communicative behavior in an interpersonal context.

Newcomb goes on to define terms and delimit his focus to communicative behavior between individuals:

> The properties of objects may be studied either objectively or phenomenally—preferably in both ways—but in any case, they are studied not as things-in-themselves, but *as related to persons*. Thus the characteristic way in which social psychologists study motivation is in terms of person-object relationships (the term "object" includes other persons, of course). Since, as we have all learned in recent years, motivational phenomena are intimately interlinked with perceptual phenomena, it is often necessary to distinguish two aspects of person-object relationships, which may be labeled the cathetic and the cognitive. Often, however, one does not need to make this distinction, while still bearing in mind that both aspects are involved, and in such instances the term "orientation" is a useful one. The term is similar to the concept of "attitude," except that it connotes "existing directedness" and not merely a predisposition or a readiness.
>
> Orientations are known, of course, only as they are inferred from observable behavior. Insofar as such behavior involves reciprocal stimulation and response (or anticipations thereof) it is traditionally referred to as "interaction." But one cannot observe interaction-in-general; one must observe discriminable units of behavior. I propose, therefore, to use as such an interaction unit *the communicative act*, defined as any observable behavior by which information, consisting of discriminative stimuli, is transmitted from a human source to a human recipient. For present purposes, it is assumed that the discriminative stimuli have an object as referent. Thus in the simplest possible communicative act, one person (A) transmits information to another person (B) about something (X).
>
> Human social behavior is thus to be studied in terms of the conditions and consequences of varying communicative acts. And problems of motivation in social behavior are to be studied in terms of orientations toward the two kinds of objects necessarily involved in communicative acts—i.e., persons as *recipients* of transmitted information and objects (including persons) as *referents* of transmitted information. *The relationship between orientations and communicative acts, as we shall see, is a*

> *circular one, so that it will be necessary to consider each of them, in turn, as varying with the other* [emphasis added]. (Newcomb, 1953, pp. 140–141)

Following a second section summarizing relevant findings concerning group membership, orientations, and communication, Newcomb moves to a section titled "Communicative Behavior as Varying with Orientation toward Persons and toward Objects." In this section he explicates the systemic relations between communicative acts and the orientations of individuals in a communication setting:

> I can hardly imagine anything that would surprise you less than to hear that communicative acts are learned in ways that seem to have something to do with rewards and punishments. I shall stop, however, only to indicate in the most general kind of way what seems to be the nature of the learning conditions of communicative behavior. These conditions have to do with what I have already referred to as the individual's necessity for co-orientation—i.e., relating himself simultaneously both to objects and to persons as actually or potentially related to those objects. . . .
>
> We may start with the assumption that orientations both toward persons as potential co-communicators and toward other objects have adaptive value; *not* to be oriented to them would mean to have no cognitive content regarding them and to have no "hypotheses" (in the Postman-Bruner sense) as to their potentialities for reward or punishment. The further assumption that *co*-orientation has adaptive value stems from what I believe to be the fact that neither kind of orientation occurs singly and independently of the other, in connection with communicative acts. First, the orientation of any communicator, A, toward B, a potential recipient of his communication, rarely, if ever, occurs in an objectless vacuum. . . .
>
> Secondly, and conversely, the orientation of the communicator, A, toward almost any conceivable X rarely, if ever, occurs in the total absence of an orientation toward B, the potential recipient of his communication. ("Autistic" verbalization, of the kind Piaget reports in young children, would, of course, represent an exception . . .). The very fact that B *is* a potential recipient requires some kind of orientation toward him. . . . Al-

most invariably, moreover, there is included in this orientation toward B some assumption—however accurate or inaccurate—about B's orientation toward the object of communication.

From this elaboration of what is perhaps only too obvious, I want to deduce a single point—that there is a necessary interdependence between co-orientation (which itself involves an interdependence of orientations) and communicative acts. . . .

Since, according to these assumptions, there are relationships of interdependence among several distinguishable orientations, it is convenient to regard them as together constituting a system. For some purposes the system is best treated as an objective one—i.e., a model employed by the observer. The elements in this system are, minimally, A, B and X (a source, a recipient and an object of communication); the interdependent orientations among them are A's toward B and toward X, and B's toward A and toward X. . . .

The implications of this model are: (1) that while at any given moment the system may be conceived of as being "at rest," it is characterized not by the absence but by the balance of forces; and (2) that a change in any part of the system may lead to changes in any of the others. I shall make one further set of assumptions about the system. . . . These assumptions are that (under the stated conditions) communication tends to result in increased similarity, or congruence, of A's and B's orientations toward X, and that, as a result of learning, communicative acts are instigated by the anticipation of increased similarity or congruence (or, alternatively, by the threat of decreased similarity or congruence). (Newcomb, 1953, pp. 147–149)

After positing adaptive advantages of his concept of *congruence,* he goes on to articulate an important aspect of his "A-B-X" system, which he considers a "strain toward congruence" (p. 149).

The systemic perspective of Newcomb's contribution and his initial observations of the relation between explanations/models at the level of subareas of psychology concludes with a view to the future:

I should like to suggest (with a good deal of tentativeness) that something along the lines of the framework of co-orientation which I have roughly sketched out may find a place in

> general motivation theory. Many, among the higher forms of animal life, at least, are capable of plural orientation, and the actual direction of behavior at any given moment often cannot be accounted for in terms of any single object-orientation, others being held experimentally or hypothetically constant. . . . I suspect that the study of social behavior can provide evidence, in ways other behavior cannot, of how behavior directedness varies with multiple orientations. If so, an adequate theory of motivated social behavior will have contributed something to a general theory.
>
> Last, and far from least, an adequate general theory would take fuller account than it does today of self-orientation. . . . Here, as in the case of other concepts of peculiar relevance to social motivation, it is my belief that more extrapolations from a general theory will not suffice. Theorists from McDougall and Freud to Murphy and Rogers have properly accorded to the self a central place; though not always, in my judgment, have all of them seen that place in its full social context. Not only are self-orientations part and parcel of other-orientations, I would insist; they are inextricable from the eternal triangle of self, other persons, and the common environment. A general theory of motivation, when it is mature enough to include these interdependent orientations, will have borrowed from a theory of motivation in social behavior, as well as helping to establish it. (Newcomb, 1953, p. 159)

Roger Barker (1960)

Roger Barker's contribution, "Ecology and motivation" (1960), includes an account of alteration of individual state(s) as a function of external, higher-order patterns or change. Like Heider and Newcomb, Barker underscores the necessity of taking individual and environment into account *as a unit* in any thorough analysis of behavior, and, hence, his contribution advances themes consistent with the conceptual frameworks advanced at the 2004 Symposium. Barker's conceptual framework is like that of Heider (1960) and Kurt Lewin's concepts of *field* and *life space* (Lewin, 1938). This provides an intellectual context in which to consider the importance of taking both in-

dividual and environment into account. At a practical level, this resonates with major themes in rehabilitation, for example, the World Health Organization's recent emphasis on the construct *participation* as the ultimate aim of rehabilitation efforts (see World Health Organization, 2001). This construct is of importance because it underscores the importance of including assessment and modification of an environment, *in addition to* clinical treatment, as a vital part of the rehabilitation process.

Barker outlines features of his concept of *psychological ecology*, including the central concept of *behavior settings*, which provides an important window on our understanding of a range of psychological phenomena as a "system" and is, at times, a very useful unit of analysis for psychology. The relevance of Barker's concepts for the issues addressed in the present volume is that, like Newcomb (1953), Barker describes a framework that explicitly relates systems concepts to adaptive processes at the social/community level.

Barker begins by incorporating from the work of Egon Brunswik an emphasis on the critical importance of including in accounts of perception and behavior the environment in which an individual acts and perceives. In Barker's words:

> Brunswik (1955) described psychological schools and theories in terms of their positions upon a macro-unit he considered to be the true vein of psychological ore. This vein extends from the environment to the environment; namely, from distal objects in the ecological environment, through proximal stimuli at the receptor surfaces of a person, through the person's peripheral receptor mechanisms, through his central processes, and through his peripheral effector systems, to his proximal reactions, or means behavior; and it finally terminates in the focus of the total unit: the person's achievement with respect to the nonpsychological world of things. The three major sectors of this unit are . . . (1) the ecological sector of objects and physical stimuli (preperceptual), (2) the organism or intrapersonal sector, and (3) the behavioral sector which occurs, again, in the ecological environment. (Barker, 1960, p. 1)

Barker, along with Brunswik, regards the entire span of the E-E (environment-environment) unit as the fundamental unit of analysis with respect to psychology; it is "the basic psychological entity."

He takes issue with some of Brunswik's conclusions, advancing the hope that taking the entire E-E span into account can lead to more than a probabilistic framework for psychological explanations:

> I hold the hope that a more detailed, conceptual, and explanatory account of the whole course of events can be achieved, particularly at the junction point between the ecological and the intrapersonal sectors of the unit, and especially with respect to motivation. This, in fact, is the theme of my paper. (Barker, 1960, p. 3)

The E-E unit, then, is to be taken as the ultimate unit of analysis; one obvious way to understand this unit is as a multisectored *system.* As can be seen in the material reproduced below, one theme that recurs in other examples of systems approaches is that of the close relation between the processes of change, perception, and motivation. A second major theme is the influence of changes or properties in one part of the system on the qualitative status of other parts of the system, a defining aspect of all exemplars of models informed by general systems theory. Finally, the interaction of sectors of the E-E unit is considered with respect to *emergent social aspects* in Barker's system:

> For a psychology defined in terms of E-E units, the usual considerations of motivation are not adequate. These considerations almost always make personal motives the whole story of the energetics of behavior, and place them within the organism. But a unit is a unit; it is indivisible. When it is a psychological unit, the environment, the organism, and the behavior are all involved, and energetics must occur in all of the parts. Either the E-E unit is false, or motivation theory is too limited. (Barker, 1960, p. 4)

Barker goes on to lay the groundwork for discussion of his theory of behavior settings by introducing some concepts that provide the context for his central theses. In a later section he provides further elucidation of the relation between the "entity" and the "environment" elements of his model:

> Ecology is concerned with relations between entity and environment. But before this statement has any useful meaning,

entity and environment must be defined. . . . Where does each entity end and its environment begin? . . .

. . . To clarify this problem, it is necessary to revert to the levels of phenomena in science. . . . I have emphasized that the essential distinction between levels is this: The laws, the explanations, which have been devised to account for occurrences on one level are inadequate to explain occurrences on a different level, *yet the levels are coupled systems.* Another distinction that is crucial for the definition of environment is that between inside and outside. Every entity has a discriminable boundary; what is within the boundary constitutes the entity's inside, and what is without constitutes its outside. . . . The environment of an entity is made up of those parts of the *outside* regions with which the entity is coupled by laws on a different level from those which govern the entity itself.

. . . Here, for ecological problems, is the basis for delimiting an entity from its environment. The test is this: As we move from any discriminable thing to more remote, surrounding parts, a point is reached at which the governing laws, so far as we know them, become incommensurate, yet the linkage remains. This point marks the boundary of the entity and the beginning of the environment. (Barker, 1960, pp. 7–8)

Barker asserts the desirability of taking the entire E-E continuum as the crucial unit of analysis, rather than abstracting only elements of it for psychological examination. He offers the study of psychological principles of learning as an example:

The field of learning is interesting in this connection. Learning is usually interpreted as the process, par excellence, by which the environment influences the organism and its behavior. This is the predominant way, almost the only way, a culture is presumed to shape the personality and behavior of the individuals born into it. The facts of learning demonstrate, however, as almost all learning theory recognizes, that even here the organism is the locus of driving forces without which learning does not occur. Indeed, within the context of learning it is, paradoxically, the behaving organism that endows the environment with behavior-controlling properties; the guiding and coercing powers of the environment have been shown to

> depend upon what activities the organism has previously had with it, and these depend more upon the organism than upon the environment. Indeed, learning studies have demonstrated that almost every discriminable part of the ecological environment *can* be coupled with almost every kind of behavior. This is important information; it defines the range of an organism's power to transform its connections with the ecological environment, and it implies that parts of the environment are almost equipotential. . . .
>
> It will be clear now where ecology enters the environment-environment unit, which Brunswik took as the realm of psychology. Psychological ecology deals with the relations between the nonpsychological sectors of this unit, governed by the laws of geometry, chemistry, economics, etc., and the intrapersonal and the behavior sectors, governed by psychological laws. (Barker, 1960, pp. 11–12)

He then attempts to formulate an account of how these incommensurable system elements might be related (or, at least, an approach to a satisfactory understanding) by exploring earlier ideas of Fritz Heider's.

Barker makes a gradual transition to his concept of *behavior settings*. Because these ideas are readily available to the interested reader, a detailed presentation will not be offered here. However, one would highlight a particularly important element of his concepts concerning behavior settings: Barker highlights how behavior settings are regions in a community that offer certain *opportunities* and, along with these, require certain *responsibilities*. Furthermore, there is a relation between the peopling of these settings and both the number of responsibilities and the adequacy of performance that can be expected to occur. This relation between the demands of a given behavior setting and the impact on the behavior and life of the individuals populating these settings seems very compatible with more recent concepts.

Implications for the analysis of complex settings and behavior are evident. Barker continues, in a section entitled "Theory of Behavior Settings":

> Field studies in which I and my associates have been engaged, of the behavior of children in their natural habitats,

have brought us to the hypothesis that under certain precisely defined and frequently occurring conditions, people stand in the relationship of media to behavior settings; and that under certain other less common conditions, people stand in the relationship of things to behavior settings, imposing certain absolute constraints on them. This hypothesis brings some order into data upon American-English differences in the behavior of children and adults, into data upon differences in the behavior of individuals in settings of different sizes, and into data concerning the behavioral consequences of physical disability. The wide ramifications of these simple ideas suggest that they may have a basic significance for psychology, and particularly for the psychology of motivation. . . .

It is first necessary to describe behavior settings. When a mother writes, "There is a baseball game in progress on the playground across the street," she does not refer to any individual's behavior, but to the behavior of children en masse. The same is true of a newspaper item which reports, "The annual fete held in the St. Ambrose Church garden was a great success."

These are behavior settings. They are highly visible behavior phenomena; laymen mention them in conversation and in writing as frequently as they do individual persons. . . . Here are . . . [some] behavior settings:

Streets and sidewalks
Kane's Grocery
Clifford's Drug Store
Gwyn Café
Pearl Café
Midwest State Bank

Of special relevance in the present connection, however, are the following characteristics of settings:

1. Behavior settings involve ongoing patterns of extraindividual behavior whose identity and functioning are independent of the participation of particular persons.
2. A behavior setting has a circumjacent soma of physical objects: of walls, doors, fences, chairs, dishes, typewriters, ad infinitum, arranged in a characteristic spatial pattern, at a particular temporal and physical locus.

3. Behavior settings are homeostatic systems; they normally persist, often for years, at a relatively stable, characteristic level. . . .

A behavior setting is a behavior entity, but its laws of operation are not the laws of individual psychology . . .

Most of what we know about behavior settings is simple description, with any conceptualizations being not far removed from the surface appearance of settings. However, this is enough to make a beginning in tracing the connections along the Brunswikian unit which has its origins in this part of the ecological environment. For our purposes, the self-regulatory characteristic of behavior settings is crucial and must be considered further; it is this, indeed, which gives behavior settings, under certain conditions, the position of things which impose their own patterns on the people within them, who have the position of media.

Behavior settings exhibit a stability-within-change, a persisting functional level which is due to a balance of many influences. Some of these issue from the larger community, some are intrinsic to the setting itself, and some originate within the individuals who populate the setting . . .

. . . Forces operate in every setting. These multiple balanced forces assure that the level of a setting is more stable than most of its parts or conditions singly. One frequently occurring means of balancing the forces and maintaining the homeostatic level of a behavior setting is compensating for a deficiency in the number or docility of the parts of the medium by an increase in the amount of energy applied to each of them, and vice versa. When the media of a setting, the machinery, the tools, or the workmen, for example, are in short supply, those available have to work longer and/or "harder." (Barker, 1960, pp. 15–21)

In the last section of his contribution, Barker discusses "People: Media of Behavior Settings":

Six features of the relationship between people and behavior settings must now be mentioned.

1. People are part of the inside manifold of behavior settings.

2. Of all the attributes of settings, people are the sine qua non. . . .
3. Each quasi-stationary level of a setting has its optimal population requirements. . . .
4. Of all the equipment and paraphernalia of a setting, people are among the most immediately malleable and adjustable.
5. Different behavior settings on the same level of functioning, and therefore with the same optimal population requirements, actually differ greatly in population. . . .
6. These five features of the relation between people and behavior settings emphasize the position of people as the media of behavior settings. This is true. However, there is one important exception. When the number of people in a setting, its population, falls below the minimal number required by its homeostatic level, the setting will be modified. (Barker, 1960, pp. 21–22)

He concludes:

> Behavior settings with less than optimal people for their homeostatic levels are self-disciplining settings. The opportunities within them are matched by the obligations they contain. . . . We sometimes call them self-discipline. In reality they are controls built into the structure and the dynamics of the setting, into the ecological environment. . . .
>
> I would like to close with two remarks: (1) Brunswik's environment-environment unit appears to be subject to more than empirical probabilistic laws, and (2) the ecological environment appears to be, especially, the seat of motivating influences. (pp. 48–49)

Barker's contribution—as is his body of scholarly work in general—is novel and interesting and would seem to have continuing applications today. In particular, the growing acknowledgment that community reintegration and quality of life are vitally important ends of rehabilitation efforts and that rehabilitation cannot really be considered a successful endeavor unless an individual is supported to the point of maximal participation in the life of the community, with the greatest degree of independence possible, leads inevitably to the recognition that there must be a satisfactory awareness of the

environment—the behavior settings and social/interpersonal environment to which an individual will be returning—before an optimal rehabilitation treatment plan can be developed and delivered. Barker's (and his students') techniques for identifying and cataloging community venues can serve as a guide in expanding rehabilitation practice to include such analyses. In this regard, in addition to Barker's work and the models of Brunswik and Heider (already referenced), additional useful resources include Gibson (1979) and Wicker (1984).

Notes

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1. Compare Theodore Newcomb's "A-B-X" model, discussed below.
2. Variables such as curiosity, novelty, and stimulus change, stimulus aspects sometimes thought to provoke increased engagement, interest, and/or increase arousal.

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